

Scope and sequence for physical science instruction at Capital City Public Charter School, Washington, D.C., recommended by Jeff Schmidt (jeffschmidt@alumni.uci.edu), 10 September 2009

CAPITAL CITY PUBLIC CHARTER SCHOOL

SCIENCE CONTINUUM

Grades Pre-K – 8

Physical Science

A. Properties of Objects and Materials

PK-K.1	Develop a growing curiosity and interest in the physical world around us.
PK-K.2	Describe the physical properties of given materials and objects -- color, size, shape, weight, density, texture, hardness, flexibility, temperature, transparency, magnetic response, wettability, ability to react with other substances, and so on.
PK-K.3	Sort objects by observable properties such as size, shape, color, weight and texture.
PK-K.4	Differentiate between properties of objects (such as size, shape, weight) and properties of materials (such as color, texture, hardness).
PK-K.5	Show familiarity and play creatively with items such as blocks, tools, tops, balls, springs, rubber bands, swings, seesaws, balances, marbles on tracks, sand, water, tuning forks, taut strings, mirrors, lenses, prisms and magnets.
PK-K.6	Identify and explore various materials such as rock, metal, glass, plastic, rubber, wax, wood, paper and cloth.
PK-K.7	Experiment with substances such as salt, cornstarch, wax, food coloring, water and ice, and describe the results.
PK-K.8	Observe, describe and compare the properties of various kinds of paper.
1-2.1	List the materials from which given objects are made.
1-2.2	Identify unknown substances through their physical properties.
	Use tools such as rulers, balances and thermometers to measure some of the characteristic properties of substances, such as melting point, boiling point, solubility and density. Explain that the physical properties of substances are independent of the size of the sample.
5.1	Demonstrate that materials may be composed of parts that are too small to see without magnification.
7-8.1	Differentiate between volume and mass. Define density.
7-8.2	Recognize that the measurement of volume and mass requires understanding of the sensitivity of measurement tools (such as rulers, graduated cylinders, balances) and knowledge and appropriate use of significant figures.
	Explain that an old theory held that everything was made from four basic “elements”: air, earth, fire and water. Combinations of these elements in different proportions gave substances their properties.
7-8.3	Explain that there are about 100 elements, which combine in a multitude of ways to produce compounds that make up all living and nonliving things.
7-8.4	Identify samples of some pure elements, including some of the following: hydrogen, helium, carbon, oxygen, aluminum, sulfur, iron, nickel, copper, zinc, silver, iodine, gold, mercury, and lead.
7-8.5	Explain that because most elements tend to combine with other elements, few elements are found in their pure form.
	Explain that all matter is made up of atoms, which are far too small to see directly through a microscope.
	Explain that the atoms of any element are alike but are different from atoms of other elements.
	Draw a model that shows the structure of an atom.
7-8.6	Differentiate between an atom (the smallest unit of an element that maintains the characteristics of

	that element) and a molecule (the smallest unit of a compound that maintains the characteristics of that compound).
7-8.7	Give examples of elements and compounds.
7-8.8	Differentiate between mixtures and pure substances.
<i>B. Position and Motion of Objects</i>	
PK-K.1	Move objects in various ways, such as in a straight line, zigzag, back-and-forth, round-and-round, fast and slow.
PK-K.2	Demonstrate how objects move when pushed, pulled, hit, thrown, slid, rolled, spun and swung.
PK-K.3	Investigate various types of motion, such as flying, swinging, spinning, rolling and sliding.
1-2.1	Describe the various ways that objects can move, such as in a straight line, zigzag, back-and-forth, round-and-round, fast and slow.
6.1	Explain and give examples of how the motion of an object can be described by its position, direction of motion, and speed.
6.2	Plot and interpret distance-vs.-time graphs for objects moving with constant speed.
<i>C. Light, Heat, Sound, Electricity, Magnetism</i>	
PK-K.1	Demonstrate that magnets attract and repel each other and attract certain kinds of materials.
3-4.1	Construct and experiment with sound-producing devices to learn where sound comes from and to investigate characteristics of sound, including pitch and loudness.
3-4.2	Explain that sound is produced by vibrating objects and requires a medium through which to travel. Relate the rate of vibration to the pitch of the sound.
3-4.3	Demonstrate and explain the reflection, focusing and absorption of sound.
3-4.4	Demonstrate static electricity phenomena such as repulsion, attraction and induction, and explain them in terms of the action of like and unlike charges. (Best done in winter, when humidity is low.)
3-4.5	Identify the parts of electrical circuits.
3-4.6	Design, build and explain series and parallel electrical circuits using batteries and lights.
3-4.7	Demonstrate that an electrical circuit must be a complete loop before an electrical current will flow in it.
3-4.8	Demonstrate that electricity can produce light, heat, sound and chemical change.
3-4.9	Identify and classify objects and materials that conduct electricity and those that are insulators.
3-4.10	Demonstrate and explain how electromagnets can be made, and give examples of how they can be used.
3-4.11	Make electromechanical devices such as buzzers and motors. Explain how they work.
3-4.12	Demonstrate that magnets have poles that repel and attract each other.
3-4.13	Identify and classify objects and materials that a magnet will attract and those that a magnet will not attract.
3-4.14	Demonstrate that light travels in a straight line until it strikes an object or goes from one medium to another, and that light can be reflected, refracted and absorbed.
3-4.15	Name materials that allow light to pass through.
3-4.16	Manipulate light, demonstrating transmission, reflection, refraction, focusing, dispersion of colors by prisms, color filtering, and absorption.
6.1	Explain that sunlight arrives at earth with a range of wavelengths, consisting of infrared radiation, visible light, and ultraviolet radiation.
6.2	Explain that human eyes respond to only a narrow range of wavelengths of electromagnetic radiation – visible light.
6.3	Explain that differences of wavelength within the visible range are perceived as differences in color.
6.4	Demonstrate and explain that light from the sun is made up of many different colors of light, even though to the eye sunlight looks white. Explain that other things that emit or reflect light have a different mix of colors.
7-8.1	Explain that energy can take many forms, such as mechanical motion, gravitational potential, electric and magnetic fields, sound, heat and light.

<i>D. Properties and Changes of Properties in Matter</i>	
PK-K.1	Investigate how various materials react with water.
PK-K.2	Examine objects and materials to predict whether or not they will float in water, and test predictions.
PK-K.3	Investigate, demonstrate and explain how properties of materials can change, such as by wetting, drying, heating, cooling, melting, freezing, dissolving, mixing, reacting with other materials, and so on.
1-2.1	Identify objects and materials as solid, liquid or gas.
1-2.2	Compare and contrast solids, liquids and gases based on the basic properties of each of these states of matter. Recognize that solids have a definite shape and that liquids and gases take the shape of their container.
1-2.3	Describe and demonstrate how water and other substances can be changed from one state to another by adding or taking away heat.
1-2.4	Begin to develop a sense of variables, which can be controlled to produce desired outcomes.
1-2.5	Investigate and demonstrate how a mixture of solids and water can be separated.
1-2.6	Investigate the extent to which various solids and liquids dissolve in water or mix with water.
1-2.7	Investigate, demonstrate and explain that some substances react with other substances.
5.1	Recognize that water exists as solid, liquid or gas. Explain how temperature affects changes in these states of matter for water, particularly in various stages of the water cycle.
5.2	Investigate and explain that heating and cooling can cause changes in the properties of substances. Examples: Liquid water can turn into steam by heating or into ice by cooling; plastic is softened by heating.
	Demonstrate and explain that elements may react chemically with other elements in characteristic ways to form new substances, called compounds, whose properties may be very different from those of the elements of which they are made. Demonstrate and explain that compounds may react chemically with elements or other compounds to form new substances with different properties.
	Explain that there are groups of elements that have similar properties -- highly reactive metals, less-reactive metals, highly reactive gases, nonreactive gases, and so on.
	Explain that substances often are placed in categories or groups if they react in similar ways; acids is an example of such a group.
	Demonstrate and explain that dissolving substances in water may greatly facilitate reactions between them.
	Explain that an especially important kind of chemical reaction involves combination of substances with oxygen, as in burning or rusting.
	Explain that atoms may stick together in well-defined molecules and that atoms or molecules may pack together in large arrays. Explain that crystals are such arrays.
7-8.1	Explain the arrangement of atoms or molecules in the four states of matter and the resulting properties of matter in each state.
7-8.2	Explain that atoms and molecules are perpetually in motion and that increased temperature means greater kinetic energy. Explain that the addition of heat to matter increases the energy of its atoms or molecules, which can cause the matter to change state from solid to liquid to gas.
	Explain why heating causes most substances to expand.
7-8.3	Differentiate between physical and chemical changes.
7-8.4	Explain that chemical elements do not break down during such processes as reactions with other elements, heating, exposure to electricity, and impact; no atoms are destroyed or created in chemical reactions, no matter how violent the process.
7-8.5	Explain that in chemical reactions, the total mass is conserved.
<i>E. Force and Motion</i>	
PK-K.1	Demonstrate that under some conditions, objects can be balanced.
1-2.1	Demonstrate that the way to change the motion of an object is to apply a force (give it a push or a

	pull). The greater the force, the greater the change in the motion of the object.
6.1	Explain that if the forces acting on an object are balanced so that the net force is zero, the object will either remain at rest, if it is initially at rest, or maintain a constant speed and direction, if it is initially moving.
6.2	Demonstrate and explain that if more than one force acts on an object along a straight line, the forces will reinforce or cancel one another, depending on their directions and magnitudes, and that any net force will affect the object's motion.
6.3	Demonstrate and explain that an unbalanced force acting on an object changes its speed or its direction of motion, or both.
6.4	Demonstrate and explain that an object subjected to an unbalanced force acting toward a center may curve into an orbit around the center.
6.5	Demonstrate and explain how simple machines change the sizes, displacements and directions of forces.
6.6	Identify the parts of simple systems and explain the functions of the parts.
6.7	Assemble and operate a simple system.
6.8	Predict what will happen to systems when various components are added or removed.
7-8.1	Differentiate between weight and mass, recognizing that weight is the amount of gravitational pull on an object.
7-8.2	Identify the forces acting on an object and explain how these forces affect the object's motion.
7-8.3	Determine and explain that the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid the object has displaced. Use this principle to predict whether an object will float or sink in a given fluid.
<i>F. Transfer of Energy</i>	
3-4.1	Identify common forms of energy -- mechanical motion (kinetic), gravitational potential, electrical, magnetic, sound, heat and light. Explain that energy is the ability to do work, such as causing motion or creating change.
3-4.2	Give examples of how energy can be transferred from one form to another.
5.1	Explain that when a warm object and a cool one are placed in contact, heat flows from the warmer object to the cooler one until they are both at the same temperature. Explain that heat transfer can also occur at a distance by radiation.
5.2	Investigate and describe how some materials conduct heat much better than others, and how poor conductors (insulators) can be used to reduce heat loss or gain.
6.1	Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.
6.2	Explain that energy cannot be created or destroyed, but only changed from one form into another.
6.3	Explain that energy in the form of heat is almost always one of the products of an energy transformation.
7-8.1	Recognize that heat is a form of energy and that temperature change results from adding or taking away heat from a system.